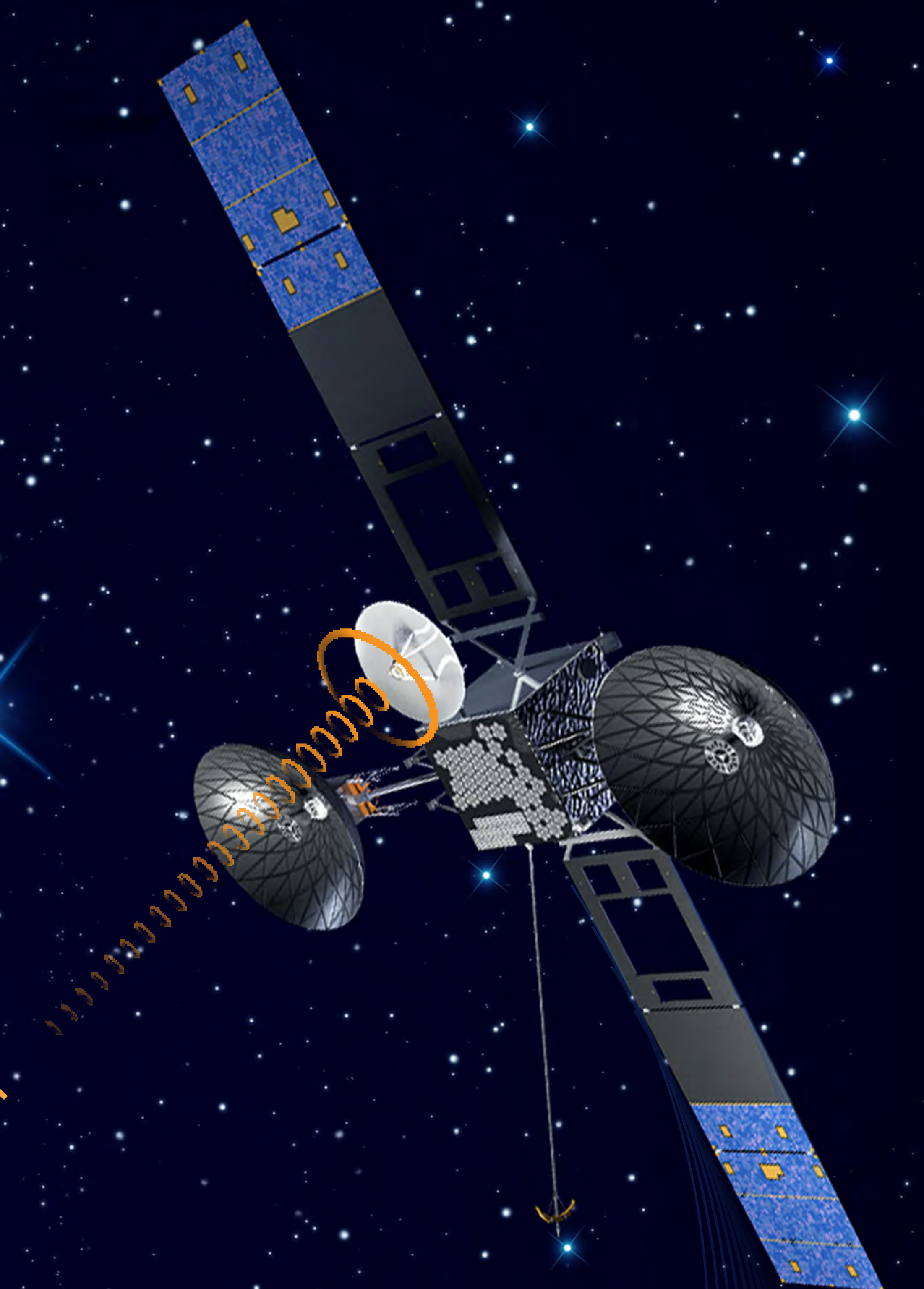
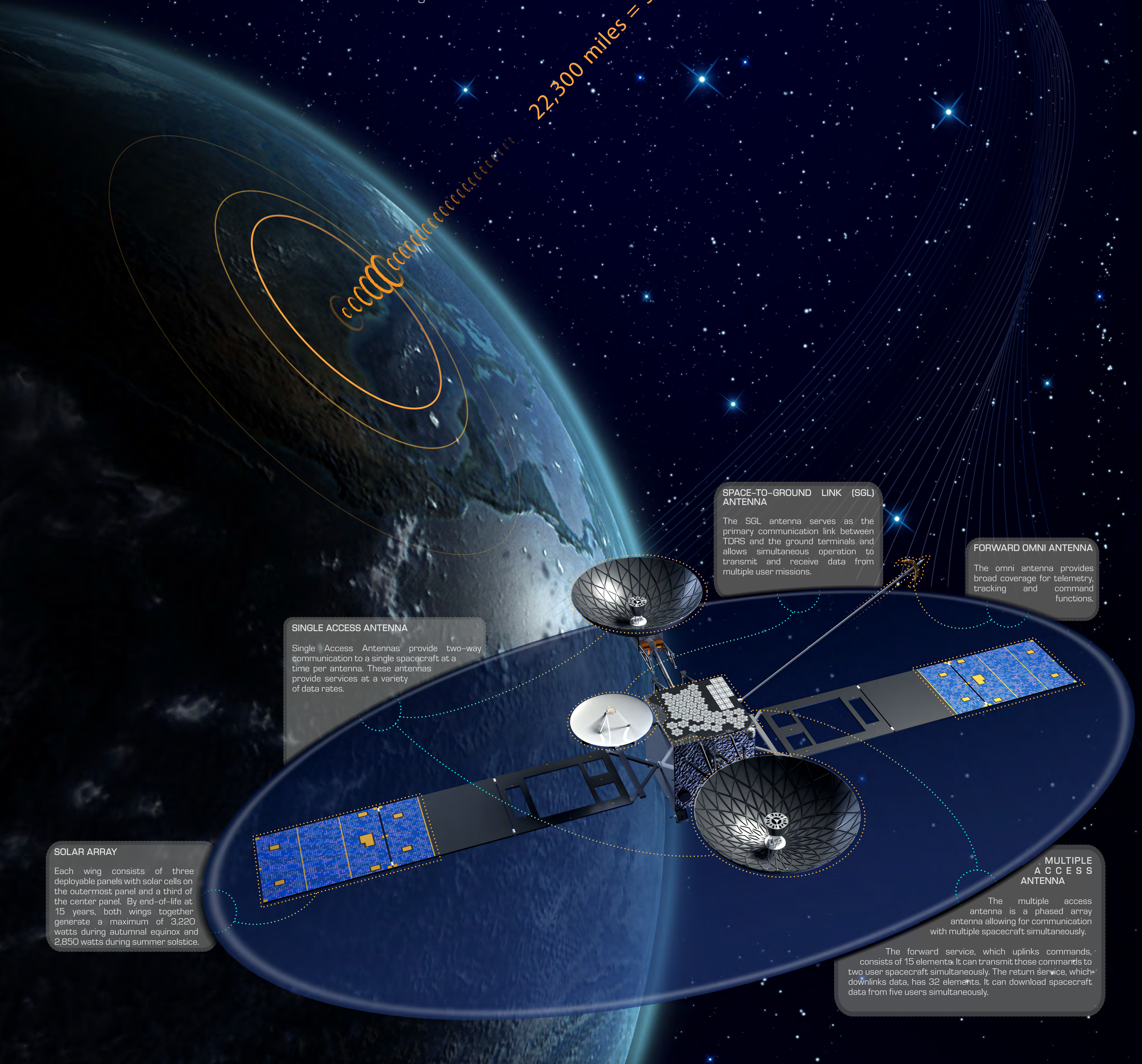
National Aeronautics and Space Administration

TDRS

CONNECTING THE UNIVERSE

TDRS spacecraft maintain stationary positions approximately 22,300 miles above the Earth. At this distance, each satellite travels in its orbit at exactly the same rate that the Earth rotates. This type of orbit, where the satellite roughly remains in the same place when viewed from a constant location on Earth, is called a geosynchronous orbit. A constellation of TDRS spacecraft is distributed around the Earth to provide global satellite communication coverage.



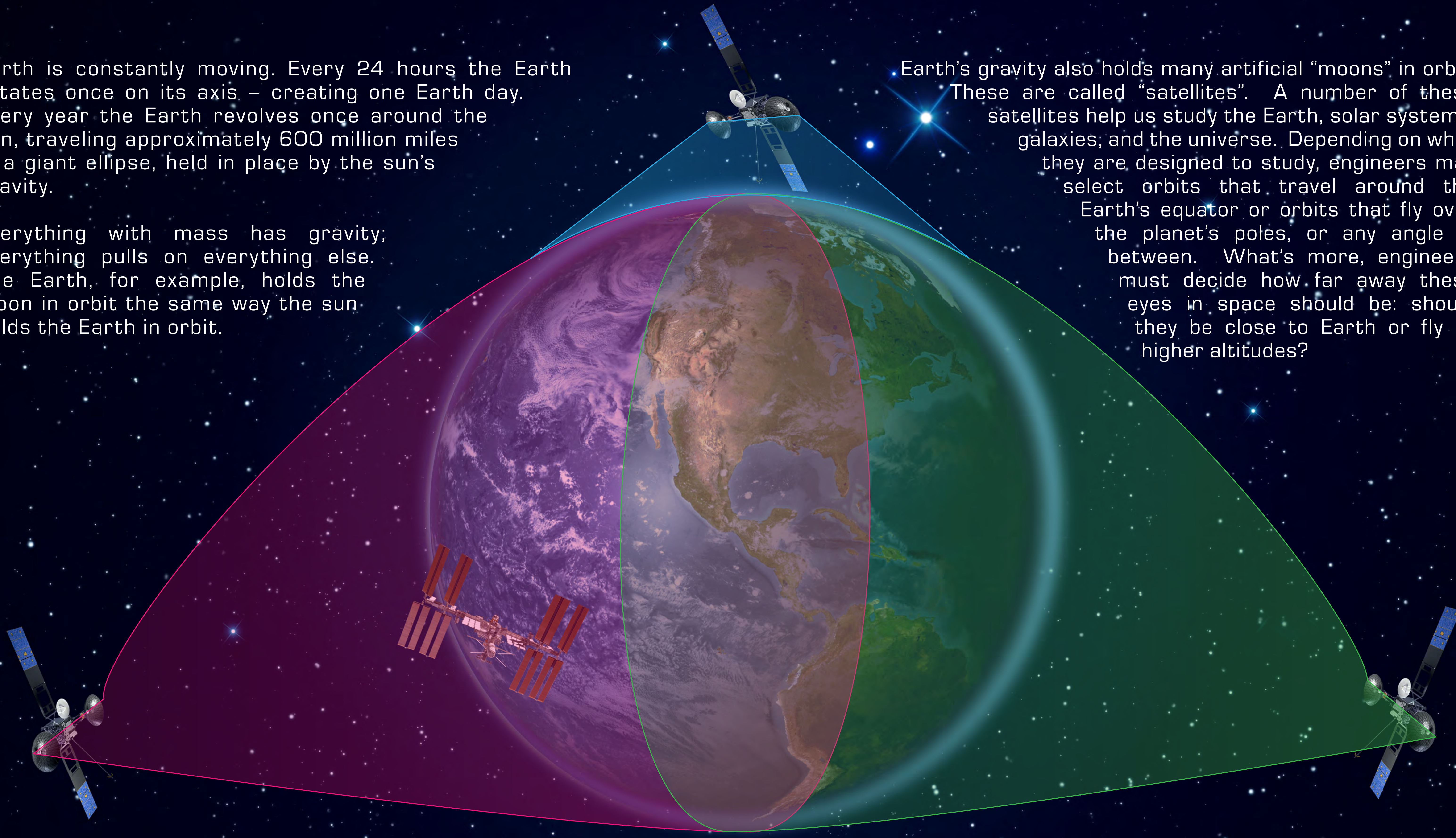


WHAT'S A GEOSYNCHRONOUS ORBIT?

Earth is constantly moving. Every 24 hours the Earth rotates once on its axis – creating one Earth day. Every year the Earth revolves once around the sun, traveling approximately 600 million miles in a giant ellipse, held in place by the sun's gravity.

Everything with mass has gravity; everything pulls on everything else. The Earth, for example, holds the moon in orbit the same way the sun holds the Earth in orbit.

Earth's gravity also holds many artificial "moons" in orbit. These are called "satellites". A number of these satellites help us study the Earth, solar systems, galaxies, and the universe. Depending on what they are designed to study, engineers may select orbits that travel around the Earth's equator or orbits that fly over the planet's poles, or any angle in between. What's more, engineers must decide how far away these eyes in space should be: should they be close to Earth or fly at higher altitudes?



Shown on this image are three TDRS spacecraft sitting in geosynchronous orbit 22, 300 miles away from Earth. So, TDRS is synched with the Earth's rotation, hence geo-(Earth) synch-(same) chron-(time) us.

The time it takes for a satellite to orbit the Earth depends on how high above the Earth the satellite is traveling. Many satellites with low orbits take just over an hour and a half to complete one revolution. A satellite at the distance of the moon would take 28 days to complete an orbit. There is a calculated distance where it takes a satellite exactly one day to complete a circular revolution about the Earth. A satellite with an orbit that is synchronous with the rotation of the Earth is called a geosynchronous satellite.

This calculated orbital distance is approximately 22,300 miles (35,800 km) above the Earth's surface. While in a geosynchronous orbit, the satellite will circle the Earth along different angled paths. Conversely, satellites at this distance can continuously look at the same region on Earth. This is very important for certain types of science and for communications.

There is only room for a limited number of satellites in these orbits, but each **Tracking and Data Relay Satellite's (TDRS)** role of relaying satellite commands and data is considered so critical that a number of these orbital slots are reserved for the TDRS constellation.

The TDRS constellation consists of multiple TDRS positioned in geosynchronous orbit, leveraging prime locations for delivering global connectivity. The TDRS fleet is not made up of research observatories looking at any particular surface feature on Earth like weather, forest canopies, atmosphere, oceans, or other things. Instead, the TDRS fleet helps to track a research satellite's location and communicate its data to scientists and other users on Earth. In other words, TDRS satellites are space-based hotlines to the ground.

The TDRS constellation is constantly in touch, talking to other satellites, transmitting information back and forth from the ground.

Without the TDRS constellation, the world would not, for example, be able to see the beautiful pictures taken by the Hubble Space Telescope. Without the TDRS constellation, NASA would not be able to have continuous contact with the astronauts aboard the International Space Station, ensuring both the astronauts' and the Station's health and safety.

Because the TDRS constellation's job is so critical, engineers have parked the TDRS constellation in prime locations above the Earth where they can stay continuously connected to the TDRS ground terminals. That's why they are in geosynchronous orbits, holding figure 8 positions over Earth's equator, making precisely one revolution-a-day.

In this picture, imagine looking down at the North Pole. The person is positioned somewhere on the Equator. Let's also imagine that he can see a TDRS spacecraft from where he is. As the Earth rotates around its axis and the TDRS travels in its orbit, the person will be looking overhead at the satellite at all times.

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